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FLUOR

January 31, 2005

Fernald Closure Project
Letter No. SP:2005-0002

Mr. John M. Sattler
U. S. Department of Energy
Ohio Field Office - Fernald Closure Project
175 Tri-County Parkway
Cincinnati, Ohio 45246

Dear Mr. Sattler:

CONTRACT DE-AC24-01OH20115, SUBMITTAL OF NEVADA TEST SITE WASTE PROFILE ONLO-000000128, REVISION 7, URANIUM METAL WASTES

Enclosed is a signed copy of Nevada Test Site (NTS) Waste Profile ONLO-000000128, Revision 7, Uranium Metal Wastes. Revision 7 is the result of the annual profile review and is being submitted to update the profile to meet the requirements of the Nevada Test Site Waste Acceptance Criteria, Revision 5. To aid in the review, we have provided a detailed list of changes made to the profile and related documents.

A suggested cover letter for transmitting this Waste Profile to Nevada is enclosed for your convenience. Should you have any questions, or require additional information, please contact Steve Heffron at (513) 648-5650.

Sincerely,

Mark Cla for

Dennis Carr
Senior Project Director
Silos Project

DC:DSA:kl
Enclosure(s)

c: David S. Adkins, MS52-3
Terri L. Binau, DOE Contracting Officer, DOE-OH
Reinhard Friske, MS52-3
Steve Heffron, MS 52-3
Ralph E. Holland, DOE Contracting Officer, DOE-OH/FCP
Dennis Sizemore, Fluor Fernald, Inc. Prime Contract, MS 2
File Record Subject Submittal of Nevada Test Site Waste Profile ONLO-000000128, Revision 7, Uranium Metal Wastes
Project Number 40600/1.1
WM Letter log copy
Administrative Record, MS 78

To: John B. Jones, NNSA/NSO

From: John Sattler

Subject: Submittal of Profile ONLO-000000128, Revision 7, Uranium Metal Wastes

Enclosed is a signed copy of Nevada Test Site (NTS) Waste Profile ONLO-000000128, Revision 7, Uranium Metal Wastes. Revision 7 is the result of the annual profile review and is being submitted to update the profile to meet the requirements of the Nevada Test Site Waste Acceptance Criteria, Revision 5. To aid in the review, we have provided a detailed list of changes made to the profile and related documents.

c: Without Enclosures
Reinhard Friske, MS52-3
Steve Heffron, MS52-3
John W. Samples, MS52-3

Fernald Closure Project Waste Profile
Uranium Metal Wastes
ONLO-000000128, Rev. 7, 01/31/05
Detailed List of Changes to ONLO-000000128

1. General- Updated profile using revision 1 of the profile form.
2. Section B.2.b- Changed the profile revision number and date.
3. Section B.6- Changed to "One Time Only" waste stream with an estimated volume of 5 m^3.
4. Section B.7- Changed estimated shipment frequency to approximately 2 shipments.
5. Section C.9- Removed inert filler material from list of waste components. This is a requirement in the profile instructions.
6. Section D.4.7- Removed Criticality Safety Evaluation 54T-03-0042. This document applied to container W229701 that has been shipped to NTS.
7. Section F.3- Removed CSE 54T-03-0042, Work Package 2002-320 and Tables A, B and C from the listed attachments.
8. Document Reference List- Removed CSE 54T-03-0042 "Nuclear Criticality Safety Evaluation for an Annular LEU Metal Ingot In a TOC Shipping Package"
9. Process Knowledge Narrative- Removed CSE 54T-03-0042 from page 6. Removed reference to the large ingot in container number W229701. This container has been shipped to NTS.
10. Removed Work Package 2002-320 and associated tables from the profile. Parts of this package were out of date. A new work package will be developed prior to packaging remaining waste covered by this profile.

Waste Profile Sheet

☒ **NTS Only** ☐ **Hanford Only** ☐ **Both NTS and Hanford**

A. Generator Information

1. Company name: Fernald Closure Project
2. Address: P. O. Box 538704, Cincinnati, OH 45253-8704
3. Generator facility: Various

4. Primary Technical Contact: David S. Adkins email: david.adkins@fernald.gov Phone: 513-648-4364
   Fax: 513-648-4925

5. DOE Contact: John Sattler email: john.sattler@fernald.gov Phone: 513-648-3145
   Fax: 513-648-3071

6. Waste Certification Official: Reinhard Friske email: reinhard.friske@fernald.gov Phone: 513-648-5477
   Fax: 513-648-5002

7. Generator's EPA Identification Number (If profile involves hazardous materials): N/A

B. General Waste Stream Information

1. Waste stream name: Uranium Metal Wastes

2.a. NTS Waste stream identification number: ONLO-000000128 N/A ☐

2.b. Hanford Profile Sheet Tracking Number:______________ N/A ☒

☐ New Profile
☒ Revised Profile (attach summary of changes) Revision Number: 7 Profile Revision Date: 01/31/05

3. Waste generating process description: *Describe the process that generated the waste stream identified by this profile sheet. Attach process flow charts and other available information if helpful in explaining the generating process.* This waste consists of the following materials:Uranium Metal Wastes. See PKN for process description.

4. Waste management services requested:
   ☒ Disposal
   ☐ Storage (Available only at Hanford)
   ☐ Treatment (Available only at Hanford); describe:
   ☐ Other; describe:

5. Waste Category (Check all that apply)
   ☒ Low Level ☐ Mixed Low-Level
   ☐ Mixed Low-Level (Generated within Nevada Only)
   ☐ "Classified Waste" ☐ "Classified Waste" requiring protection from visual observation
   ☐ Asbestiform Low-Level Waste ☐ 11(e)2 By-product Material (Small Quantities)
   ☐ Transuranic Waste ☐ Hanford Category 1 LLW
   ☐ Hanford Category 3 LLW ☐ Exceeds Hanford Category 3 LLW
   ☐ DOE Equivalence GTCC ☐ Contains accountable nuclear material

6. Estimated volume: ☐On-going (m^3/yr): Total remaining volume (m^3):
   ☒One Time Only (m^3):5

7. Estimated frequency of shipments per fiscal year: Approximately 2 shipments

C. Physical/Chemical Characterization

1. Physical/Chemical process knowledge. Describe the process knowledge information used for physical/chemical characterization of this waste stream:

☐ Material Safety Data Sheets. Attach MSDSs used to designate this waste stream (Hanford Site users can list Hanford MSDS numbers below in lieu of providing MSDSs).

☐ Mass balance from process inputs. Describe how process inputs are controlled and recorded:

☐ Historical process and analytical data. Describe:

☐ Inert debris characterized by inventory control. Check this box when the waste stream consists largely of inert debris items that are characterized by inventory control procedures and recorded on inventory sheets. Briefly list or describe inventory procedures:

☒ Other. Describe: Production process requirements were such that process knowledge is used for RCRA determinations. Historical production data such as process control specifications, historical sampling and MC&A data were used for characterization of this waste.

☐ Physical/chemical characterization varies. Check this box when the characterization strategy varies from container to container. Describe below the strategy used to meet the acceptable knowledge requirements of the waste acceptance criteria.

2. Physical/chemical analysis. Describe the sampling and analysis performed to characterize this waste stream:

☒ No analysis performed.
☐ Field screening performed. Describe the frequency and type of field screening performed:
☐ Laboratory analysis performed. Describe the sample source and sampling frequency and methods: List the analytical methods used, including upper confidence limits and explanations of anomalies for all analytes analyzed. Attach representative analytical sample result summary. For NTS, attach Table B-1 and data validation summary.

3. Regulatory status. Check all boxes below that describe the regulatory status of the waste stream:

☐ Federally regulated (RCRA) hazardous waste (40 CFR 261). List all RCRA U, P, F, K or D waste codes that could apply to the waste stream; place waste codes that do not apply to all containers in parentheses:
☐ For Hanford only, Washington State dangerous waste (WaAdminCode173-303), excluding W001. List all Washington waste codes that apply; place waste codes that do not apply to all containers in parentheses:

☐ For Hanford only, Washington State dangerous PCB waste (Waste code W001 of WaAdminCode173-303): Describe PCB source and concentration:
☐ TSCA regulated PCB (40 CFR 761). Describe category of PCB (i.e. PCB waste, PCB bulk product waste, PCB remediation waste, PCB analytical waste, etc). Describe PCB source and concentration:
☒ Waste generated from cleanup activities conducted under CERCLA
☐ Waste is not regulated under any of the above regulations.
☐ Waste is hazardous per state-of-generation regulations? If yes, identify hazardous components and state regulations.

4. Federal land disposal restrictions. Check all boxes that apply:
☒ Waste stream is not subject to federal land disposal restrictions

☐ Waste stream requires treatment to meet land disposal restrictions of 40 CFR Part 268.
If checked, provide the following information:
☐ Wastewater ☐ Nonwastewater ☐ Hazardous debris
☐ Waste contains Underlying Hazardous Constituents (applicable UHCs must be included in Item C.9)
Was the waste treated after August 24, 1998? Yes ☐ No ☐

☐ Waste stream meets some of the applicable land disposal restrictions of 40 CFR 268. Check this box if the waste has been treated to meet some federal land disposal restrictions or if it meets some federal land disposal restrictions as generated. If checked, describe the treatment performed and analytical data to support LDR determination:

☐ Waste stream meets all applicable land disposal restrictions of 40 CFR 268. Check this box if the waste has been treated to meet all federal land disposal restrictions or if it meets the land disposal restrictions as generated. If checked, describe the treatment performed and analytical data to support LDR determination:

Waste Profile Sheet

5. (For Hanford only) Waste characteristics. Check any of the boxes for regulated characteristics (WaAdminCode173-303-090) that apply to the waste stream:

☐ Flash point < 38°C ☐ Flash point 38°C - <60°C ☐ Flash point 60°C – 93.3°C
☐ Ignitable solid ☐ Oxidizer
☐ pH 2 or less ☐ pH 12.5 or greater
☐ Liquid that corrodes steel at a rate greater than or equal to 0.25 inches/year
☐ Reactive cyanide ☐ Reactive sulfide ☐ Water Reactive
☐ Explosive, unstable or pyrophoric ☐ Generates toxic gases, vapors or fumes

6. Physical state:
☐ Liquid ☐ Sludge ☐ Debris ☒ Solid
☒ Powder/Dust ☐ Sealed Source ☐ Encapsulated ☐ Solidified
☐ Other; describe:

7. Liquid form. If the waste stream contains liquid, check all that apply:
☐ Containerized liquid ☐ Absorbed Liquid ☐ Stabilized liquid

8. Other contents: Check any of the following that are components of the waste stream, and provide a description of how the waste acceptance criteria for each are met:

☐ Animal carcasses ☐ Infectious waste ☐ Vegetation ☐ Free liquids

☐ Chelating agents ☐ Organic liquids ☐ Asbestos waste ☒ Particulates EW-1016

☐ Gases ☐ PCBs ☐ Explosives ☐ Pyrophorics

☐ Beryllium Dust ☒ Other
Hydrogen Gas Generation, WM:PKGG-T-0026 and EW-1016

9. Waste composition. Describe the gross composition/component of the waste stream and all hazardous constituents that contribute to any waste codes or LDR treatment standards.
☐ If the chemical composition varies greatly from container to container, check this box and provide bounding values or ranges here. Further evaluation will occur on the specific package paperwork as it is provided for highly variable streams

CAS Number	Chemical constituent	Waste Component	Estimated weight percent ☒ Estimated volume percent ☐
		Uranium Scrap Metal- MEF #3813	98.5%
		Project Related Trash and Debris	1%
		Boron Carbide	0.5%

D. Radiological Characterization

1. Radiological process knowledge. Describe the source(s) of the radioactive material in this waste stream (i.e., the radiological processes that introduced the radioactive material into the waste stream).
This waste is uranium metal from historical processing.

2. Radiological characterization methods. Describe the analysis and characterization methods used to determine the radionuclide inventory of the waste stream. Check all that apply.

☒ Radionuclide material accountability. Describe the accounting methods used to help establish the radionuclide inventory:Site MC&A material accounting methods
☒ Radiochemical analysis. Describe type and frequency of sampling and analysis: *For NTS, attach Table B-1 and data validation summary* Historical process sampling and analysis data. Product grade uranium was sampled on a regular lot basis throughout the production years.
☐ Nondestructive assay. Describe type and frequency of assay performed:

Waste Profile Sheet

☐ Field measurement instruments. Describe the type of instruments and how they are used to help establish the radionuclide inventory:
☐ Scaling factors. Explain how the scaling factors were derived and how they are used:
☐ Computer models. Describe the computer model used and how it is used to establish the radionuclide inventory:
☒ Other. Describe method:Ratios such as calculating U-234 and U-236 based on the uranium content and U-235 enrichment levels were used as part of the radiological characterization.

If several methods are checked above, describe how the methods are used together to establish the radiological inventory of the waste stream. For complex or highly variable waste streams, explain the strategy used to meet the acceptable knowledge requirements of the waste acceptance criteria. NA

3. Estimated Radiation Dose of disposal package (mSv/hr):

Surface0.015 to 0.05 30 cm0.012 to 0.039 One Meter0.005 to 0.013

4. (Section D 4 need not be filled out for Hanford only profiles)
☒Yes ☐No Does the waste contain enriched uranium (^{235}U wt% ≥ 0.90), ^{233}U, ^{239}Pu, ^{241}Pu, ^{242m}Am, ^{243}Cm, ^{245}Cm, ^{247}Cm, ^{249}Cf, ^{251}Cf? If yes, answer the following and check those that apply for compliance with the criticality safety criteria of the NTSWAC. If no, skip to Section D.5.

4.1 ☒ Attach completed NTSWAC, Appendix E, Table E.3, ^{235}U FGE and ^{235}U Effective Enrichment, for each enrichment level or range.

4.2 ☐ Waste package contains 15 g of ^{235}U FGE or less.
Specify controlling document:

4.3 ☐ Fissile material does not exceed 350 g of ^{235}U FGE per package nor does it exceed 2 g of ^{235}U FGE per kilogram of waste (mass of the package is not included in the mass of the waste) (graphite and beryllium must not exceed 1% of the mass of the waste).
Specify controlling document:

4.4 ☒ Waste complies with the limits and conditions as specified in NTSWAC, Appendix E, Table E.4.
Specify controlling document: EW-1016

4.5 ☐ Graphite and beryllium exceeds 1% of the mass of the waste.

4.6 ☒ Waste complies with the limits and conditions as specified in NTSWAC, Appendix E, Tables E.5 and E.6. Specify controlling document: EW-1016

4.7 ☒ A waste specific nuclear criticality safety evaluation (NCSE) was performed to show compliance with the NTSWAC, Section 3.2.1. Attach NCSE for review and specify controlling document: EW-1016, CSE-A490.101, CSE-A490.103

5. Reportable radionuclides. List the radionuclides that could be reportable in the waste stream:
☒ If the nuclides vary greatly from container to container, check this box and provide bounding values or ranges here. Further evaluation will occur on the specific package paperwork as it is provided for highly variable streams. *Note: For the NTS, concentrations must be entered in Becquerel/cubic meter.*

Isotope	Concentration Ci/m3 **(Bq/m3)**; Range and Activity Representative of Final Waste Form
U-234	1.6E+09 to 4.9E+11 1.2E+11
U-235	1.0E+08 to 7.5E+10 5.7E+09
U-236	(6.7E+04) to 3.8E+10 7.8E+09
U-238	1.1E+10 to 2.4E+11 2.0E+11
Np-237	(1.3E+05) to 2.6E+08 4.2E+07
Tc-99	(6.6E+05) to 8.2E+10 1.3E+10
Pu-239	(1.8E+04) to 3.7E+08 5.9E+07

Waste Profile Sheet

6. Does the waste contain any alpha-emitting transuranic radionuclides with a half-life greater than 5 years, ^{241}Pu, or ^{242}Cm? If yes, list below.

Transuranic Nuclide	Concentration (nCi/g); Range and Activity Representative of Final Waste Form
Pu-238	(4.0E-04) to 7.3E-02 1.1E-02
Pu-239	(4.0E-04) to 6.0E-01 8.3E-02
Pu-241	(2.0E-04) to 4.0E+00 5.9E-01
Am-241	(4.0E-04) to 8.2E-02 1.7E-02
Np-237	(4.0E-04) to 4.0E-01 6.0E-02

7. Are there any packages in this waste stream that exceed the Plutonium Gram Equivalent limits specified in NTSWAC, Section 3.2.2? Yes ☐ No ☒
   Provide container type(s), quantity, and supporting PGE calculations. PGE calculations attached

8. For Hanford only, Total FGE as defined in Hanford Site Solid Waste Acceptance Criteria, HNF-EP-0063.

E. Packaging

1. Packaging used. Check the applicable boxes.
   ☒ Drum; describe size(s), type, and weight range: 30 gal, metal drum, 45 kg to 228 kg; 55 gal, metal drum, 45 kg to 440 kg; 85 gal, metal drum, 45 kg to 441 kg; 110 gal, metal drum, 45 kg to 410 kg; all drums are either excepted packaging, IP2 or 7A packages

   ☒ Metal box; describe size(s), type, and weight range 81-1/4"(L)x57-1/4"(W)x40-1/2"(H), metal box, 273 kg to 4082 kg; 83-1/4"(L)x56-1/2"(W)x46"(H), 273 kg to 4082 kg, boxes are either excepted packaging, IP2 or 7A packages
   ☐ Wood box; describe size(s), type, and weight range:
   Do the Metal or Wood boxes meet the 3,375 lb/ft^2 strength test? Yes X No ☐ N/A ☐

   ☐ High integrity container; describe size(s), type, and weight range:
   ☒ Intermodal transport container; describe size(s), type, and weight range:20'x8'x8', ISO cargo container, 10000 kg to 19048 kg, excepted packaging
   ☐ Other container; describe size(s), type, and weight range:
   ☐ Bulk waste – bulk package and shipment dimensions and weight ranges – describe (supersack, burrito wraps, equipment, etc.):
   ☒ Vented; describe type of venting: As required, 3/4" to 2" NucFil
   ☐ Shielded; describe type of shielding:
   ☒ Sorbents; describe type and amount used: As required for condensate control specified in procedure WM:PKGG-A-0002 (Absorbent Determinations), absorbent pads, from 2 to 8 layers or granular, from 1 to 104 lbs., both depending on shipping container.
   ☐ Radiologically stabilized in concrete or other stabilization agent; describe type and amount of material used and provide data to demonstrate waste meets stabilization criteria:

2. Maximum container size: 6.1m x 2.44m x 2.44m

3. Maximum container gross weight: 19048 kg

4. Describe any liners/protective coatings used to ensure that the container is compatible with the waste: NA

5. Does each container meet each of the package criteria as defined in the waste acceptance criteria?
   ☒ Yes ☐ No
   List documentation that demonstrates compliance with waste acceptance criteria.

The Fernald controlling document is PT-0014, Procurement of Storage and Shipping Containers. Container specific test data is available upon request.

6. Reference any special handling procedures and ALARA documentation, if applicable. NA

Waste Profile Sheet

F. Additional Information

1. Comments: NA

2. Exception or Deviation Request to waste acceptance criteria: Complete if needed
   a) Identify specific requirement for which an exception or deviation is desired:
   b) Provide reason an exception or deviation is needed:
   c) Describe any proposed alternative methods to meet the general intent of the requirement:

3. Attachments. List any attachments provided with this profile: Document Reference List, Table E.3, PE-g Calculations for Metal Drum, PE-g Calculations for Metal Box, Process Knowledge Narrative

G. Generator Signatures

To the best of my knowledge, the information provided on this form and the attached documentation is a full, true and accurate description of the waste stream. Willful and deliberate omissions have not been made. All known and suspected hazardous materials have been disclosed.

Technical Contact Name: David S. Adkins

Signature: David S. Adkins

Date: 1/31/05

Waste Certification Official Name: Reinhard Friske

Signature: John W Stanzak
for and on behalf of
Reinhard Friske

Date: 1-31-05

Plutonium Gram Equivalent Calculations for
Reportable Isotopes included in NTS Profile ONLO-000000128, Rev.7
2/2/2005

Isotope	Package Activity, Bq/m3	PE-g Conversion Factors	PE-g/m3
U-233			
U-234	4.90E+11	1.13E-10	5.54E+01
U-235	7.50E+10	1.05E-10	7.88E+00
U-236	3.83E+10	1.07E-10	4.10E+00
U-238	2.40E+11	1.02E-10	2.45E+01
Th-230			
Th-232			
Np-237	2.60E+08	4.60E-10	1.20E-01
Tc-99	8.20E+10	7.08E-15	5.81E-04
Pu-239	3.70E+08	4.35E-10	1.61E-01
		PE-g/m^3 =	**9.21E+01**
Drum Waste Volume (m^3) =	1.20E-02	**Drum Total PE-g =**	**1.11E+00**
Box Waste Volume (m^3) =	7.20E-02	**Box Total PE-g =**	**6.63E+00**
Inermodel Waste Volume (m^3) =	5.76E-01	**Intermodel Total PE-g =**	**5.31E+01**

Profile ONLO-000000128, Revision 7

Table E.3: Calculation of U^{235} Fissile Gram Equivalence and Effective U^{235} Enrichment for LLW Packages

Nuclide (A)	High Activity Conc. (Bq/m3) (B)	Volume of Package (m^3) (C)	Activity (Bq) (D)	Specific Activity (Bq/g) (E)	Mass of Isotope (g) (D/E=F)	U^{235} FGE Factors (G)	U^{235} FGE (FxG=H)	If FGE is >1% of U^{235} Mass, then include (I)
U^{233}			0.0E+00	3.6E+08	0.0E+00	1.4E+00	0.0E+00	
U^{235}	7.50E+10	0.01067	8.0E+08	8.1E+04	9.9E+03	1.0E+00	9.9E+03	9.9E+03
Pu^{239}	3.70E+08	0.01067	3.9E+06	2.3E+09	1.7E-03	1.6E+00	2.7E-03	2.7E-03
Pu^{241}	2.50E+09	0.01067	2.7E+07	3.8E+12	7.0E-06	3.5E+00	2.5E-05	2.5E-05
Am^{242m}			0.0E+00	3.6E+11	0.0E+00	5.4E+01	0.0E+00	
Cm^{243}			0.0E+00	1.9E+12	0.0E+00	7.8E+00	0.0E+00	
Cm^{245}			0.0E+00	6.4E+09	0.0E+00	2.3E+01	0.0E+00	
Cm^{247}			0.0E+00	3.5E+06	0.0E+00	7.8E-01	0.0E+00	
Cf^{249}			0.0E+00	1.5E+11	0.0E+00	7.0E+01	0.0E+00	
Cf^{251}			0.0E+00	5.9E+10	0.0E+00	1.4E+02	0.0E+00	
Effective U^{235} Enrichment =			**Total U^{235} FGE (9.885E+03)/Total grams uranium (2.0316E+05)**				**TOTAL U^{235} FGE**	**9.9E+03**
			Effective U235 Enrichment =			**4.86**		

Document Reference List
for Profile ONLO-000000128, Revision 7

DOE-OH-00-0001	Ohio Field Office Recycled Uranium Project Report
EW-0001	MEF Characterization Process Procedure
EW-1016	Waste Management Work Authorization Program
MS 11-BD/E-420-23	Manufacturing Specification- Reduction of Depleted/Enriched UF_6 to UF_4
PL-3048	Prototype Sampling and Analysis Plan for Waste at the FCP
PT-0014	Procurement of Storage and Shipping Containers
PT-0018	Preparation of Documentation of Off-Site Shipment of Hazardous Material
RM-0005	FCP Lot Marking and Color Coding System
RM-0053	Waste Characterization Information Manual
SOP 11-C-207	Reduction of UF_6 to UF_4 (<2.1% U-235)
WM:CHAR-T-0001	Radiological Characterization for Waste Disposal
WM:PKGG-A-0001	Certification of Low Level Radioactive Waste and Supporting Paperwork
WM:PKGG-A-0002	Absorbent Determination
WM:PKGG-T-0026	Safeguards for Handling Hydrogen and Methane Gas-Generating Materials, Pyrophoric Materials, and Bulging/Pressurized Containers
WM:SHIP-T-0003	Inspection of Waste Packages and Loaded Transport Vehicles
CSE-A490.101	Nuclear Criticality Safety Evaluation of Low Level Waste Disposal At the Nevada Test Site Radioactive Waste Management Sites, Current Revision
CSE-A490.103	Nuclear Criticality Safety Evaluation of Low Level Waste Disposal At the Nevada Test Site Radioactive Waste Management Sites, Current Revision

PROCESS KNOWLEDGE NARRATIVE
PROFILE ONLO-000000128, REVISION 7
URANIUM METAL WASTES

FORWARD

This narrative describes the uranium metal waste inventory stored at the Fernald Closure Project (FCP) that is included in NTS Profile ONLO-000000128. A wide variety of high quality uranium metal products and uranium metallic scraps were generated by the former production operations at the FCP. Additionally, the FCP received many similar materials from offsite locations, because the site served as the DOE repository for surplus uranium materials.

HISTORICAL PERSPECTIVE OF FCP SITE OPERATIONS

The historical processes at the FCP included ten production plants, each having a specific mission that supplied the succeeding plant with an intermediate product for further processing until the eventual uranium form was produced. Operations began in October 1951, with the completion of the Pilot Plant as an operating prototype of the entire production process to develop performance data for designing large-scale equipment while producing limited quantities of uranium metal. In December 1953, the Sampling Plant (1) became operational for receiving, weighing, sampling, and storing feed materials from both onsite and offsite sources. The three Metal Production and Fabrication Plants (5, 6, and 9) became operational by 1953. All five Chemical Plants (2/3, 4, 7, and 8) became operational within the following year. During its 37 years of operation, the FCP delivered nearly 170,000 metric tons uranium (MTU) of high purity metal in a variety of configurations and enrichment assays to DOE user sites at Hanford, Savannah River, and Oak Ridge. Approximately 35,000 MTU of uranium oxides and compounds were delivered to the Gaseous Diffusion Plants located at Paducah and Portsmouth.

FORMER PRODUCTION OPERATIONS

Chemical Process Operations in Plants 2/3, 4, 7, 8 and the Pilot Plant

The FCP production process began with the conversion of impure uranium feed materials and recycled residues to pure uranium trioxide (UO_3) in the Ore Refinery Plant (2/3), beginning in December 1953. This was accomplished in a three-step operation that began with acid-leaching uranium from dry solid feed materials followed by solvent extraction processing to produce a highly pure solution of uranyl nitrate (UNH). Pure UNH solution underwent thermal decomposition to UO_3.

Plant 4 began operating in October 1953 for converting UO_3 that was either produced in Plant 2/3 or received from offsite to uranium tetrafluoride (UF_4), commonly called green salt, by a two-step operation. In the first step, UO_3 was reduced by hydrogen to form uranium dioxide (UO_2), which was then converted to green salt using anhydrous hydrofluoric acid in the second step. Green salt product was the source material for making uranium metal derbies in the Metals Production Plant (5) beginning in May 1953.

Green salt was also produced in the Hexafluoride Reduction Plant (7) and the Pilot Plant by a direct process that reduced uranium hexafluoride (UF_6) by hydrogen to form UF_4. Plant 7 operated for only three years, beginning in June 1954, primarily for supplementing the supply of normal uranium green salt produced by Plant 4 to meet the peak metal demands of the mid-1950s. Depleted UF_6 was processed to UF_4 in the Pilot Plant during this period to support the classified D38 Program at the Oak Ridge Y-12 Plant.

The Scrap Recovery Plant (8) began operations in November 1953 for upgrading process residues to a form suitable for uranium recovery in Plant 2/3. Process residues were numerous forms of low-assay uranium materials that were generated by all production operations and offsite operations at Reactive Metals, Inc. (RMI) and at Weldon Spring. Examples include MgF_2 slag, sump filter cakes, dust collector materials, incinerator ash, and off-specification UO_3 and UF_4. Low-grade metal scrap that was unacceptable for recycling via remelting was furnaced to black oxide (U_3O_8). After screening, the fine material fraction became acceptable feed for Plant 2/3 operations and the coarse material fraction was further oxidized in a furnace.

<u>Metal Production and Fabrication Operations in Plants 5, 6, and 9</u>

Plant 5 converted UF_4 into uranium derbies, weighing as much as 370 pounds each, by a thermite reduction process using magnesium metal granules. By-product magnesium fluoride (MgF_2) slag was generated in substantial quantities by the reduction process. Most derbies were cast into ingots along with high purity recycle metal scraps, either in Plant 5 or in Plant 9, depending upon the isotopic enrichment. Dimensions of cylindrical ingots were sized to the specific end-use configurations required by the reactor sites. As-cast ingots were cropped by sawing approximately 2 inches from the top section to remove shrinkage cavities and impurities that rose to the top of the melt during solidification. Cropped ingots were sent to the Plant 6 Rolling Mill and the Special Products Plant (9) for center-drilling and surface machining. Uranium alloy produced for DOD applications were in a slab casting configuration. High-purity derbies were also shipped to other DOE sites after surface cleaning was performed.
In Mid-1952, the Rolling Mill and Machining Areas of the Metals Fabrication Plant (6) became operational for fabricating cropped ingots into finished uranium cores. Cylindrical cropped ingots having a diameter of 6-8 inches and 60 inches length were heat treated prior to the rolling mill operation. Equipment in this operation consisted of an ingot furnace, blooming mill with reversing rolls, shearing devices, molten salt heat treating furnace, and conveyors. The blooming mill operation produced an oval billet having nominal dimensions of 1¾ inch x 2 ¼ inch. After shearing and heat treating, the oval billets

advanced to a six-stand finishing mill for producing rod stock having standard diameters in the range of 1 to 2 inches. In 1971, the rolling mill operation was shut down and all machined ingots were heat treated in Plant 6 before they were shipped to RMI for extrusion into tubes.

Beginning in 1973, Savannah River implemented the production of the Mark 31 depleted (0.20 percent U-235) production stream. The process generally began with UF_4 feed from the Paducah inventory and continued at the FCP to produce heat-treated machined ingots for shipment to RMI (Reactive Metals Incorporated). At RMI, ingots were extruded to tubes and returned to the FCP Plant 6 machining operations for producing finish machined target element cores.

CHARACTERIZATION OF URANIUM METAL WASTE

CONTROL OF NUCLEAR MATERIAL AT THE FCP

A wide variety of uranium metal products and scraps were generated by the former FCP production operations and from other sites within the DOE complex. Control of these various forms of materials was maintained by the "FCP Lot Marking and Color Coding System (RM-0005)." This system continues to be used along with inventory data in the Sitewide Waste Information, Forecasting, and Tracking System (SWIFTS) at the site.

Uranium metal from the production operations was packaged into material lots and assigned a 15-digit code according to the five basic elements of the Lot Identification System. The elements consisted of a 4-digit Production Order Number (PO), 3-digit Source Code (SRC), 1-digit Enrichment Class Code, 3-digit Material Description Code (MDC), and 4-digit Lot Sequence Number. This system can provide substantial process knowledge information on the entire inventory of uranium wastes and is utilized to characterize them for offsite disposal.

URANIUM METAL WASTE

As discussed in the section on Former Production Operations, green salt (UF_4) was the source material for the production of uranium metal. Knowledge of the UF_4 production process (SOP 11-C-207, MS 11-BD/E-420-23 and DOE-OH-00-0001), sample data from sampling events of UF_4 (SP-175D, SP96-1210 and Confirmatory Sampling and Analysis Group 162C), knowledge of the uranium metals process (DOE-OH-00-0001) and quality control sample results obtained during the production of uranium metals indicates this waste is not considered hazardous waste under Federal, Nevada or Ohio RCRA regulations and does not require treatment to meet appropriate LDR requirements.

Sample analyses of UF_4 (above referenced sample plans) indicates the following maximum values relative to TCLP concentrations for RCRA regulated metals: arsenic(3.8 ppm), barium(16.5 ppm), cadmium(0.4 ppm), chromium(1.4 ppm), lead(1.3 ppm), selenium(ND @ 0.2 ppm), silver(0.7 ppm) and mercury(ND @ 0.0002 ppm). The production of UF_4 and the subsequent production of uranium metal did not include the use of RCRA regulated solvents. None of these compounds are known or expected to be present as contaminants. No K-listed, P-listed or U-listed wastes have been mixed with this waste.

Based on a review of historical sample data, process knowledge and MC&A data, the wastes under this profile contain between 10% and 100% uranium with a weighted average of 84.6%. U^{235} enrichment is between 0.14% and 4.8% with a weighted average of 0.44%. The profile inventory includes approximately 2% (by weight) of waste that exceeds 1.25% enrichment. The remainder of the profile inventory is less than or equal to 1.25% enrichment. With the exception of MDC 076, Zirnlo Ends, the waste under this profile has a weighted average uranium content of 98% with a weighted average U^{235} enrichment of 0.33%. Some uranium metal cores were cladded in metal alloy (copper and zirconium) as product material. Recycled cores were sent to the Plant 9 Zirnlo unit for decladding of the alloy. In preparation of decladding the cores, the ends were sawed off. This material is referred to as "Zirnlo Ends". Because of the amount of cladding material, this waste falls between 10% and 20% uranium. Other radionuclides present may include members of the uranium decay chain and some quantities of fission products and transuranic nuclides. The fission products and transuranic nuclides are a consequence of low concentrations of these nuclides that were present in reactor-recycle material that was initially processed at the reactor site prior to shipment to FCP. None of the waste samples had transuranic concentrations approaching 100 nCi/g; the total of all alpha-emitting transuranics found in the samples was less than 5.2 nCi/g.

The uranium metal in the narrative has the potential for generating hydrogen (H_2) gas if confined in moist air for an extended period of time. These wastes will be packaged and processed per FCP procedures required for packaging of hydrogen generating materials. WM:PKGG-T-0026 specifies the safeguards for handling hydrogen gas generating materials. The project specific work authorization package will specify the packaging requirements for drums, metal boxes or ISO containers and include steps, which address materials identified as possible hydrogen gas generating materials. EW-1016 is the controlling document for the FCP Waste Management Project Work Authorization Program, which requires that project specific details be addressed. EW-1016 will require concerns regarding hydrogen gas generation or other special packaging requirements be addressed in the project specific work authorization package, which will be in place prior to packaging these containers for shipment.

Additionally, small amounts of uranium oxides resulting from surface oxidation of uranium metal may be present in containers of uranium metal packaged for shipment. The uranium oxides, if present in sufficient quantities in the waste package could constitute a fine particulate waste as defined by NTSWAC. To comply with subsection 3.1.6 of the NTSWAC, waste meeting the definition of fine particulate wastes will be shipped to NTS in secure packaging.

As stated above, special packaging requirements will be addressed in the project specific work authorization package, which will be in place for packaging these containers for shipment. As part of the packaging process, if void space is present in the containers during the packaging operation, the void space will be filled with inert material such as vermiculite or sand. Clean crushed drums may also be used as void space filler material. The code 2 derbies will be packaged in 55-gallon drums with MgF_2

(included in NTS Profile ONLO00000129, Revision 1) that the FCP has in its inventory. The bottom of the 55-gallon drums will be lined with two layers of Super-Absorbent Quick-Solid and a derby placed in the drum. Approximately 400 pounds of magnesium fluoride will be added to surround and cover the derby. The void space at the top of the drum will be filled with vermiculite

Section 3.2.1 of the NTSWAC outlines the requirements for completing a criticality safety evaluation (CSE) for certain enriched materials. A good portion of the inventory in this profile exceed the values discussed in Section 3.2.1 above which a CSE is required. As stated above, special packaging requirements will be addressed in the project specific work authorization package, which will be in place for packaging these containers for shipment. Waste under this profile that would otherwise require a CSE will be packaged in a manner to ensure each container is below the applicable U-235 maximum gram limit per package as listed in Tables E.4, E.5 and E.6 of the NTSWAC and as defined in Table 1 of NTS document "Nuclear Criticality Safety Evaluation of Low Level Waste Disposal At the Nevada Test Site Radioactive Waste Management Sites", current revision (CSE-A490.101) or Table 2 of NTS document "Nuclear Criticality Safety Evaluation of Low Level Waste Disposal At the Nevada Test Site Radioactive Waste Management Sites", current revision (CSE-A490.103). When using CSE-A490.103, boron carbide will be used as a flux moderator. The packaging of all materials will be performed under the oversight of the FCP WMP Quality Control Operations who will document the packaging meets the requirements as stated above.

MEF 3813, Uranium Scrap Metal

Uranium metal managed in MEF 3813 was generated at the FCP during metal production and fabrication operations (as previously described) as well as from offsite sources within the DOE complex. For profiling purposes, this uranium metal is divided into the seven component categories, per the "FCP Lot Marking and Color Coding System", RM-0005.

Low-Grade Scrap Metal (MDCs 001 - 099)

053 – Non-burnable Metal with Uranium Content

055 – Depleted U Metal, Not for Reactor Product Streams

056 – Depleted U Ingot Crops (Top Crops) From Primary Ingots

070 – Rockwell Spills

076 – Zirnlo Ends – To Be Classified for Recovery

080 – Partially Oxidized Metal for Sorting, Containing Metl-X

081 – Partially Oxidized Metal for Sorting, Containing No Metl-X

The low-grade materials (MDCs 001-099) were reused as recycle scrap. These uranium materials were suitable for remelting into a large variety of sizes, shapes, and isotopic levels of uranium metal products. Recycle metal was also received from offsite, and the remelted products were then shipped to other DOE sites.

High-Grade Scrap Metal (MDCs 100 - 149)

103 – Ingot Crops (Top Crops) From Primary Ingots

104 – Metal Spills and Extrusion Ends; High in Impurities and Spills

113 – Zirconium Clad Metal From Offsite. To Be Declad by Zirnlo System

119 – Solid Metal, Other than Cores, With Embedded Steel

120 – Chemical Reject Primary Ingots

124 – Zirnlo; Partially Declad Fuel Elements

128 – Clad Uranium metal; Declad By Machining or Chemical Treatment

130 – Partially Oxidized Metal for Dissolver

131 – Partially Oxidized Metal Oxidation Feed

136 – Metal To Be Oxidized

139 – U Alloyed or Canned With Elements Other Than Al, Mo, or Zr

141 – Clad Metal for Acid Dissolution – Not for Zirnlo Processing

High-grade Scrap Metal were materials determined by sample analysis data or process knowledge to require chemical treatment, furnacing to U_3O_8, or machining prior to processing for uranium recovery. Alloys and clad metal were received from other DOE sites and from the private sector. Chemical treatment or furnacing was required for MDCs 124,128,130,131,136,139, and 141. Machining was performed on certain metal scraps to yield U metal that was suitable for recycle via remelt operations in Plants 5 and 9.

Intermediate Products (MDCs 200 - 270)

218 – Clean Prill for Double Melting

219 – Metal from Spills for Double Melting

220 – Code 2 Derbies for Double Melting or Shot Cleaning

221 – Solid Metal for Pickling Prior to Remelt Does Not Require Blending (<12")

222 – Solid Metal, Physical Reject Ingots for Sawing/Crushing and Pickling Prior to Remelt

223 – Solid Metal to be Sawed, Sheared, or Crushed, But Not Pickled Prior to Remelt

224 – Solid Metal, Not Pickled, Other than Spills and Top Crops for Double Melting

227 – Metal Samples for Double Melting

228 – Solid Metal to Be Pickled

230 – Sawed Sections for Pickling from Primary Ingots Containing 1st Generation Crops

231 – Sawed Sections for Pickling from Primary Ingots Containing No Top Crop Metal

234 – Physical Reject Billets To Be Sawed Prior To Remelt

235 – Tubular Elements To Be Crushed

236 – Extrusion Butts To Be Pickled

238 – Solid Metal for Pickling and Double Melting, Other Than 1st Generation Top Crops

240 – Double Melt IngotsTo Be Sawed and Pickled Prior To Remelt

242 – Chemical Reject Ingots/Material to Be Sawed and Pickled Prior To Remelt

246 – Ingots from Offsite to Be Reworked

251 – Chemical Reject Solid Metal for Pickling Prior To Remelt

Intermediate Products were high-grade scrap metal and metal-bearing materials produced onsite or received from offsite sources that were determined by sample analysis data or process knowledge to have sufficient quality for use in subsequent production operations. These materials required some form of chemical or mechanical treatment prior to recycle via remelt operations in Plants 5 and 9. Some were received from the reactor sites or the RMI Extrusion Plant.

Remelt Feeds (MDCs 300 - 340)

302 – Briquettes

304 – Solid Remelt Metal, Low Impurities, Not Requiring Blending or Pickling

306 – Experimental Shapes, Including Classified Shapes, Not To Be Crushed

307 – Zirnlo Product

308 – Ingot Crops and Duds

311 – Savannah River Standard Metal for Remelt

313 – Pickled Crops from Hanford Works Metal

314 – Pickled Primary Ingot Sections Containing 1st Generation Top Crops

315 – Pickled Primary Ingot Sections Containing No Top Crop Metal

322 – Chemical Reject Solid Remelt Metal – Does Not Require Pickling

323 – Reject Elements - Outer

324 – Reject Elements - Inner

327 – Pickled Reject Billets or Billet Sections

335 – Crushed Tubular Elements

336 – Pickled Extrusion Butts

337 – Declad Metal, Other than Zirnlo

Remelt Feeds were high-grade scrap metal produced from onsite chemical or mechanical treatment operations that yielded U metal suitable for recycle via remelt operations in

Plants 5 and 9. Some were received from the reactor sites, the RMI Extrusion Plant, or from other locations.

Casting Products (MDCs 400 - 419)

401 – Special Solid Ingots or Slabs

Casting Products were high-grade uranium metal products from foundry operations in Plants 5 and 9.

Rolling And Extrusion Products (MDCs 450 - 462)

451 – Mark 15 Extruded Tubes - Inner

Rolling and Extrusion Products were high-grade uranium metal products from metal fabrication operations in Plant 6 and the RMI Extrusion plant.

Machining Products (MDCs 500 - 599)

506 – Special Machined Shapes

The Machining Area had six automatic bar machines, four turret lathes, a degreasing and pickling facility, and a hydraulic press for compacting pickled machining chips and turnings into briquettes for recasting into ingots. Rolled rods were loaded into an Acme-Gridley machine and cut to a nominal 8-inch length called a core blank for beta heat-treating. A Bardons and Oliver lathe was also used for cutting core blanks from either rod stock or extruded tubes.

Heat-treated core blanks were drilled and reamed in an Acme-Gridley; then, surface machined in a Sundstrand lathe; and finally end-faced and radiused on both ends in a Heald machine. Likewise, tubular elements were produced by cutting extruded tubes from RMI into core blanks, heat treated blanks were reamed on a 6-spindle Acme bar machine; then, surface machined on a lathe; and finally end-faced on a Bore-matic machine.

Project Related Contaminated Trash and Debris

Small volumes of Personal Protection Equipment (PPE) and assorted forms of project related trash (such as plastic, paper, wood, bolts, glass, bags, etc.) are generated during the preparation of containers for shipping uranium wastes. These materials may be packaged in some of the uranium waste containers, depending upon the availability of freeboard space. This material does not exceed 1% of the total estimated waste stream weight. Negligible activity is added to the shipment by the presence of these materials and does not increase the total activity within the number of significant figures reported. The added volume is not included in the estimate of the waste volume used in calculating volume activity concentrations. This yields a conservative value for the volume activity concentrations.